Lat 39.06935 Lon-120.63245

Forest Health Protection

Pacific Southwest Region
Northeastern California Shared Service Area

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To: District Ranger, American River Ranger District, Tahoe National Forest

Subject: Forest Health Biological Evaluation of the Cuckoo Project (FHP Report NE12-05)

At the request of Kelly Pavlica, Silviculturist, American River Ranger District, Tahoe National Forest, Danny Cluck, Forest Health Protection (FHP) Entomologist, and Bill Woodruff, FHP Plant Pathologist, conducted a field evaluation of the Cuckoo project area on June 19, 2012. The objectives of the visit were to evaluate stand conditions, identify any forest insect and disease problems, and discuss potential silvicultural treatments. Kelly Pavlica and Larry Peabody accompanied us in the field.

Background

The Cuckoo project area is located about 11 miles NE of Foresthill, CA at elevations ranging between 4200 and 5000 feet (approximately centered on 39.0693N and 120.6324W). Annual precipitation is approximately 55" at the lower elevations and 65" at the upper elevations. The lower elevations and more south facing slopes are dominated by ponderosa pine (*Pinus ponderosa*) and black oak (*Quercus kelloggii*) with scattered sugar pine (*Pinus lambertiana*) and incense cedar (*Libocedrus decurrens*) (Figure 1). The upper elevations are primarily Sierra mixed conifer with ponderosa pine, white fir (*Abies concolor*), sugar pine, incense cedar, Douglas-fir (*Pseudotsuga menziesii*) and black oak growing in wild stands. Land management objectives for this project area include thinning trees to reduce stand density, increase tree health, increase structural and spatial diversity, retain large diameter conifers and black oaks, reduce surface/ladder fuels and shift stand composition to more shade intolerant species. Fuel reductions will be further achieved through prescribed fire.

Figure 1. Dense shade tolerant conifers growing under large diameter black oaks, sugar pines and ponderosa pines

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Observations

Insect and/or disease caused tree mortality is occurring at low levels within the Cuckoo project area despite mostly overstocked stand conditions. The exception to this is the higher levels of western pine beetle (*Dendroctonus brevicomis*) caused mortality of ponderosa pine. A few groups of large diameter ponderosa pine were killed by western pine beetle in recent years. These pockets now contain snags and down logs (Figure 2).

Figure 2. Ponderosa pine snags and adjacent opening created by western pine beetle caused group kill.

Heterobasidion root disease (*Heterobasidion occidentale*) was suspected in one stand where previous hand thinning revealed stem decay in white fir stumps (Figure 3). Other observed agents present but not of particular concern were:

- Red ring rot (*Phellinus pini*) - found on the boles of a few Douglas-fir within one of the mixed conifer stands (Figure 4).
- Western gall rust (*Endocronartium harknessii*) was observed on ponderosa pine seedlings and saplings (Figure 5).
- Incense cedar rust (*Gymnosporangium libocedri*) was observed on a few incense cedars.

Figure 3. Delaminated decay of small white fir stump suspected to be caused by *Heterobasidion occidentale*.

Figure 4. "Pini" conks on mature Douglas-fir.

Forest Health Protection aerial surveys have detected elevated mortality levels for white fir, sugar pine and ponderosa pine over the past few years within and adjacent to the project area (Table 1 and Figure 6). This mortality was greatest in white fir (caused by fir engraver beetle, *Scolytus ventralis*,

Figure 5. Western gall rust canker on stem of ponderosa pine sapling.

attacks), growing in mixed conifer stands, or in ponderosa pine growing in pure stands.

Discussion

Elevated levels of tree mortality in this area, as well as in the rest of the Sierra Nevada range, are strongly associated with periods of below normal precipitation and high stand density. Successive dry years can exacerbate unhealthy stand conditions, such as those that exist within the Cuckoo project area; resulting in higher levels of bark beetle caused tree mortality. For example, the higher tree mortality levels that were recorded within and adjacent to the project area during the period of 2004 -2006 followed successive dry years from 2001 to 2004 within the Sierra Cascade zone (Zone 3, Palmer Hydrologic Drought Index Data for California). Most of the affected stands were in an overstocked condition. The Palmer Hydrologic Drought Index is also included in Table 1 to highlight the relationship between drought and tree mortality.

Table 1. Acres, dead trees per acre, total dead trees and Palmer Hydrologic Drought Index (PHDI) by year within and adjacent to the Cuckoo project area (Figure 6) as estimated from annual FHP aerial detection surveys.

Year	Acres	Dead Trees/Acre	Total # of Dead Trees	PHDI*
2011	589.8	1.0	613	2.52
2010	128.4	1.7	218	0.53
2009	492.8	2.1	1,040	-2.52
2008	159.3	1.1	170	-2.71
2007	2.5	13.8	34	-2.64
2006	1,353.3	1.0	1,368	2.71
2005	4,031.5	3.0	12,220	0.37
2004	1,919.1	2.3	4,386	-1.22
2003	0.0	0.0	0	-0.54
2002	0.0	0.0	0	-2.12

*Palmer Hydrologic Drought Index for the Sierra Cascade Climate Division obtained from NOAA. PHDI values ranging from -1.00 to -1.99 are considered mild drought conditions, -2.00 to -2.99 are moderate drought conditions and -3.00 to -3.99 are severe drought conditions.

High stand density combined with drought conditions cause extreme moisture stress in individual trees, thus reducing their ability to fend off bark beetle attacks. Healthy conifer species defend themselves by producing resins that drown attacking beetles. When trees are stressed, resin pressure is reduced and the probability of successful bark beetle attack in increased. High stand density may also improve conditions for the bark beetle pheromone communication system, which facilitates mass attacks on individual trees by some bark beetle species, by concentrating the pheromone plume under a full canopy.

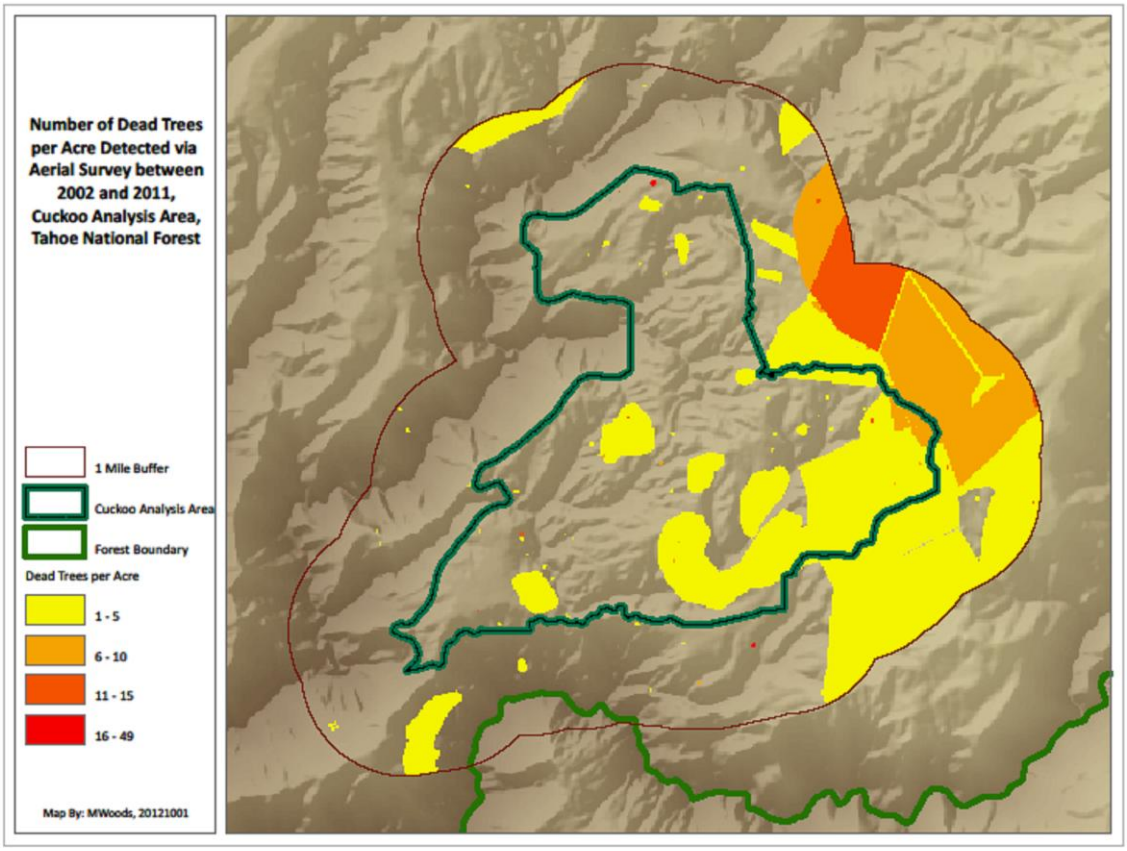

Figure 6. Number of dead trees/acre mapped between 2002 and 2011 within and adjacent to the Cuckoo project.

Predicted climate change is likely to impact trees growing in the Cuckoo project area over the next 100 years. Although no Tahoe National Forest specific climate change models are available at this time, there is a general consensus among California models that summers will be drier than they are currently. This prediction is based on the forecasted rise in mean minimum and maximum temperatures and remains consistent regardless of future levels of annual precipitation (C. Mallek and H. Safford, *A summary of current trends and probable future trends in climate and climate-driven processes in the Eldorado and Tahoe National Forests and neighboring Sierra Nevada*). The risk of bark beetle caused tree mortality will likely increase for all conifer species under this scenario, especially drought intolerant white fir. Improving the resilience of stands to future disturbance events through density, size class and species composition management will be critical to maintaining a healthy forested landscape.

Recommendations

The best strategy to decrease the amount of additional mortality in the immediate and long-term is to reduce stand density through thinning. Thinning will increase the health and vigor of residual trees by reducing competition for limited soil moisture (Fettig et al. 2007). Opening up the canopy may also disrupt the pheromone communication system by creating convection currents and air turbulence through increases in soil temperature (Bartos and Amman 1989).

The District is proposing to reduce stand density within the Cuckoo project area to reduce the threat of stand replacing wildfire and increase individual tree health and vigor. Ponderosa pine dominated stands will be thinned to an average of 80 to 120 sq.ft./acre and mixed conifer stands will be thinned to an average of 140 sq.ft./acre.

The proposed thinning treatments should reduce the density in most stands to a level that reduces the risk of bark beetle caused mortality. In most cases, thinning to a stand density that is 80% or less of "normal" basal area for the site would effectively reduce tree competition for limited water and nutrients and reduce the susceptibility to future bark beetle related mortality. Thinning to this level would also be consistent with recent direction from the Regional Forester that suggests designing thinnings to "ensure that density does not exceed an upper limit (for example: 90% of normal basal area, or 60% of maximum stand density index)" and to "design thinnings to ensure that this level will not be reached again for at least 20 years after thinning." (Regional Forester letter, "Conifer Forest Density Management for Multiple Objectives", July 14, 2004).

When planning thinning treatments, it should be recognized that the target stand density is an average to be applied across the landscape and some variability may be desired. Individual high value trees, such as mature pines and black oaks, should benefit by having the stocking around them reduced to lower levels. Areas of pure or nearly pure ponderosa pine would also benefit from lower stocking levels as well as an increase in species diversity. Allowing for denser tree spacing and pockets of higher canopy cover may be desirable around potential wildlife trees, such as fork-topped trees or larger ponderosa pines that have dwarf mistletoe brooms. When implementing thinning projects, retaining more drought tolerant species such as ponderosa pine, Douglas-fir, sugar pine and incense cedar over true fir will increase species diversity and make the stand more resilient to disturbance agents such as insects, disease, and fire. In addition, when selecting trees for removal, preference should be given to trees severely infected with western gall rust (especially younger pines with stem galls), dwarf mistletoe, root disease and trees infested with bark beetles. Small group selections should be utilized to remove root disease pockets and clumps of trees with heavy dwarf mistletoe infections. For all thinning operations, it is recommended that a registered borate compound be applied to all freshly cut conifer stumps >14" dbh in order to reduce the chance of new Heterobasidion root disease centers being created through harvest activity. However, the treatment of true fir stumps may not be beneficial if stands already have a high level of *H. occidentale* (formerly fir, or S-type, annosus root disease).

Sugar pine should be retained as much as possible during any thinning operation in order to preserve genetic diversity, especially white pine blister rust (*Cronartium ribicola*) resistant individuals. White pine blister rust, a non-native pathogen, has continued to weaken and kill this species over most of its range since its introduction into the Pacific Northwest in 1910. Identification and protection of local rust resistant trees for seed collection, if not already occurring, will aid in the future planting of rust resistant seedlings. Planting selected openings created through thinning operations with rust resistant stock would help insure this species persists in the area.

The use of prescribed fire as a primary fuels treatment or as a follow up treatment to stand thinning may result in unacceptable levels of tree mortality depending on management objectives. This mortality most often occurs as a direct result of cambium or crown injuries incurred by individual trees during the fire and not from a subsequent build up and spread of bark beetles within the burned stand. Mature ponderosa and sugar pines are also especially susceptible to mortality during prescribed burns because of the deep duff and litter that accumulates at their base. These duff

mounds typically burn at a slow rate, while maintaining lethal temperatures, causing severe cambium injury. Black oaks are also susceptible to high levels of cambium injury due to the accumulation of surface fuels at their base. If the retention of individual high value black oak and large diameter pine is desired, such as for wildlife habitat, the District should consider raking the duff away from the bases of these trees before burning.

Potential for FHP Funding

Forest Health Protection may be able to assist with funding, including NEPA, for thinning and removing green material from overstocked areas within the Cuckoo project area. Thinning projects in this area would meet the minimum requirements for western bark beetle funding and are supported by this evaluation. If you are interested in this competitive funding please contact me for assistance in developing and submitting a proposal.

If you have any questions regarding this report and/or need additional information please contact Danny Cluck at 530-252-6431.

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Citations:

Bartos, D.L., Amman, G.D., 1989. Microclimate: an Alternative to Tree Vigor as a Basis for Mountain Pine Beetle Infestations. RP-INT-400. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT, 10 pp.

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